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# THE PRESENT STATUS OF THE LARCH SAWFLY, (LYGAEONEMATUS ERICHSONII HARTIG), IN CANADA, WITH SPECIAL REFERENCE TO ITS SPECIFIC PARASITE, MESOLEIUS TENTHREDINIS MORLEY

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## INTRODUCTION

One of the most outstanding instances of the benefits to be derived from the importation of parasites of our injurious insects, be they of foreign or domestic origin, is to be found in a study of the Larch Sawfly situation in Canada, especially in Manitoba, during the past twenty years.

The Larch Sawfly, *Lygaeonematus erichsonii* Hartig, was discovered in America by Hagen in the Harvard Arboretum in 1881. It is thought to be of European origin, first, because of its partiality to European Larch (*Larix europaea*) wherever it comes in contact with this species of its host, and, secondly, because of its widespread depredation in America, due, no doubt, to the absence of its natural enemies in this country. Before 1906 very little attention was paid to this insect in Europe, and Packard's work in the eastern United States during the period 1882-1884 was the only American data available.

## PARASITE COLONIZATION

In 1906, Dr. C. G. Hewitt began an intensive study of the life history of the Larch Sawfly in England, and continued this study in Canada upon his appointment to the position of Dominion Entomologist in 1909. The introduction of parasites from England was part of the project, special care being taken to procure *Mesoleius tenthredinis* Morley, the parasite which investigations in England had shown to be of the greatest economic importance. Specimens of this parasite were liberated in the vicinity of Ottawa and in Algonquin Park, Ont., in 1916. The following year cocoons from England were distributed under infested larch stands in the following places: Ottawa; Lorette, near Quebec City; Ste. Agathe des Monts, Que.; Point Platon, on the St. Lawrence River twenty miles west of Quebec City; and in Algonquin Park, Ont. In addition a small lot of cocoons was shipped to the State Entomologist for liberation in Michigan, U. S. A. In 1912, Manitoba was selected as the destination of imported cocoons, because of the heavy Sawfly injury to the extensive stands of larch on the muskegs of that Province. Parasitized cocoons were put out in heavily infested larch stands near Treesbank and in the Riding Mountain Reserve.

## RECOVERIES AND RECOLONIZATION

The first evidence of the definite establishment of *Mesoleius tenthredinis* Morley in Canada was noted by Mr. Norman Criddle at Treesbank, Man., in 1916, when parasitism of the Larch Sawfly by *M. tenthredinis* was found to be

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19 per cent. In 1927, the parasitism was 22 per cent, in 1919 40 per cent and in 1920 it reached 66 per cent. A scarcity of sawflies at Treesbank prevented further records until 1926 when parasitism was found to be 66 per cent. In the following year it ran as high as 88 per cent, with an average of 75 per cent over a considerable area.

During the 1928 season all the liberation points mentioned in the preceding section were visited, with the exception of Algonquin Park which was reached in 1929, and cocoons were collected where possible. As a result of this survey, *Mesoleius tenthredinis* was recovered from Busteed, Ont., a point approximately two hundred miles east of Treesbank, Man., and also from Glen Murray, Que., a point forty miles distant from the Point Platon liberation point. One hundred cocoons collected in the fall of 1929 at the latter point yielded 30 *M. tenthredinis*.

In 1927, parasitized cocoons of the Larch Sawfly were collected in Manitoba by Mr. Criddle and shipped to the Dominion Parasite Laboratory, Chatham, Ont. There they were put out on moist sand under inverted shell vials and held at room temperature to obtain the parasites they contained. Upon emergence the adults of *Mesoleius tenthredinis* Morley were liberated in a sawfly infested stand of larch which formed part of a Scotch Pine-Larch plantation at the Provincial Forest Station, St. Williams, Ont.; from the same source in Manitoba a further liberation was made in 1928 at the same place. Recolonization of *Mesoleius tenthredinis* Morley at St. Williams was made in an attempt to establish it there for redistribution elsewhere, because of the excellent facilities for cocoon collection in the ground cover on the sand of that district. Recoveries of the parasite were made the following year at this point, and again in 1930.

In July and August, 1929, at St. Williams, sawfly injury completely defoliated the infested larch stand where *Mesoleius tenthredinis* was being recolonized, with the result that the ground under the trees was subjected to the direct rays of the sun during a long period of drought, consequently there was almost one hundred per cent mortality of the sawfly larvae in cocoons in the litter under the trees. This killing of the sawflies almost upset our recolonization experiment. However, the parasite had already begun to spread the previous season and was found in a well shaded area one quarter mile distant, where there is a secondary canopy of hardwood under the defoliated larch. It is hoped that this will contain sufficient stock for building up the parasite population.

### INFESTATION SURVEYS

While the recovery survey of the liberation points was being made in 1928, the sawfly infestation was also noted. In Manitoba it was down to a minimum and cocoons were collected, with difficulty; liberation points in Quebec showed a maximum of 20 per cent sawfly infestation with an average of 8 to 10 per cent. Cocoons were very scarce in the vicinity of Ottawa, while Northern Ontario showed quite a high percentage of sawfly infestation. New Brunswick was almost entirely free of sawfly injury, after a very heavy infestation the previous season, and a similar condition was reported for Nova Scotia.

In the summer of 1929 the area from Toronto to Winnipeg was traversed by train, the writer travelling by day to plot the larch stands and note the degree of sawfly infestation. Fairly high sawfly infestation percentages were noted throughout the whole area, with the exception of the area traversed by the Canadian Pacific Railway from Winnipeg to Ignace. During this survey an attempt was made to collect cocoons in the area between Winnipeg and Busteed, where *Mesoleius tenthredinis* was known to occur, but such an attempt proved fruitless owing to the extensive forest fires burning in the area immediately west of Busteed, Ont.

Officers of the Entomological Branch in New Brunswick and Manitoba reported that the Larch Sawfly infestation was very light in these provinces during 1929. The situation in Quebec remained unchanged with a continued light to medium infestation.

A two weeks' survey of southwestern Quebec during late August and early September, 1930, failed to find even a general light sawfly infestation in that region, with the exception of a small area at Mississquoi Bay, Que., which showed 75 per cent stripping. A decided increase in sawfly population was also noted in the same season from Arnprior, North Bay and Campbellford, Ont. In the vicinity of Belleville, Ont., sawfly infestation was heavy on dry ground and lighter in swampy areas. In Manitoba, Mr. Criddle reported that sawflies were very scarce, and New Brunswick was similarly situated. Sawflies were reported quite common in Richmond County, N. S.

## ECOLOGICAL STUDY

With the information that the sawfly infestation dropped to a minimum in 1928 after being extremely heavy during 1927 in New Brunswick, the same occurrence taking place in Quebec in 1930 after a medium infestation during 1929, and because such conditions are at present inexplicable, it was decided to start a thorough ecological study of the Larch Sawfly in the vicinity of Belleville, Ont.

Two larch plots have been laid out, the one on dry, shallow, gravelly loam over limestone and the other on a typical swamp or muskeg type of soil. The plot on dry ground shows a heavy infestation the current season and infestation in the swamp plot is down to, or near, the minimum, which provides two very dissimilar types of infestation suitable for such an ecological study of the Larch Sawfly.

The following observations are being made in each plot: number, age, condition and size of tree; number of branches per tree; amount of light available per tree; type and density of stand; type of soil and ground cover; previous and current year's sawfly oviposition curls per branch; percentage sawfly eggs per curled twig; number of larvae hatched per twig; number of first, second, third and fourth stage larvae and eventually cocoons per curled twig; and any other data peculiar to individual trees.

The following observations on control agencies are also being made: larval dissections to determine parasitism in each stage; cocoon collection to determine rodent injury as well as parasite and sawfly emergence from cocoons; larval collection by birds and fungous infection of cocoons in the litter under the trees.

## PARASITE PROPAGATION

During the season of 1929 an attempt was made to breed *Mesoleius tenthredinis* Morley under laboratory conditions to supplement, to a small degree, the very few parasites that have been available from field collections during the last few years. Many different types of cage were used, as well as the several stages of the larvae of the Larch Sawfly, under as diversified conditions as possible, with the result that the last remaining female *M. tenthredinis* oviposited in several half grown sawfly larvae in a large cage out of doors. These larvae subsequently died.

During the present season, however, successful parasitization of Larch Sawfly larvae was secured under laboratory conditions.. A small cotton covered cage measuring 8" x 8" x 10" was used. Second, third and fourth stage larvae were exposed singly to the mated females of *M. tenthredinis* and a total of 536 larvae were parasitized by eight parasites. The larvae were fed on larch twigs in three-inch tin salve boxes, a maximum of ten larvae in each box, the food being replaced daily. Particular care was taken not to handle larvae directly with tweezers, all transfers of larvae being accomplished by moving the larch needle upon which the larva was feeding.

In spite of all precautions in handling and feeding the larvae, 80 per cent died before spinning cocoons for the winter. Larvae parasitized in the first, second and fourth stages showed the highest percentage mortality and the third stage parasitism came through to the cocoon with the least mortality.

The parasite prefers the cephalo-ventral region of the sawfly larva for oviposition, but does not always select that region. The operation of oviposition is accomplished very quickly and usually a drop of blood oozes from the oviposition puncture as the parasite leaves the larva.

## SUMMARY

1. *Mesoleius tenthredinis* Morley has become established in Manitoba and Quebec, and at St. Williams and Busteed, Ont.

2. *Mesoleius tenthredinis* Morley was undoubtedly instrumental in reducing the Larch Sawfly population in Manitoba to a minimum.

3. Infestation surveys show that Ontario alone, in eastern Canada, shows Larch Sawfly injury the present season.

4. It is hoped that a thorough ecological study of the Larch Sawfly situation will aid materially in clearing up the present mysteries of its sporadic outbreaks and declines in Eastern Canada.

5. Successful parasitism of the Larch Sawfly by *Mesoleius tenthredinis* Morley has been accomplished under laboratory conditions.

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# A NEW MAYFLY GENUS FROM NORTH CAROLINA *

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This paper records the capture and rearing of a new genus and species of mayfly from the mountains of North Carolina, to which the name *Oreianthus purpureus* is herewith assigned. The nymph of this new genus has been taken at but two stations. It was first found in Davidson River in Transylvania Co., within the borders of Pisgah National Forest, and near the little town of Pisgah Forest. Davidson River, a tributary of the French Broad River, is a stream of brown water, rather deep and swift, flowing over a rocky bed. In June 1929, three nymphs were collected here, and two more were taken in June 1930. Repeated and long-continued search in the same stream at the place where the nymphs were first found, as well as at other points above and below, failed to yield more than the five mentioned. All of these were mature at the time of capture, and from them one female subimago and one female imago were reared.

In October 1929, two immature nymphs of the same genus and species were taken from a branch of Mitchell River near the town of Mountain Park, in Surry Co. Mitchell River is likewise a brown water stream with a rocky bed, but less deep and swift than Davidson River, and is tributary to the Yadkin River.

The nymph of *Oreianthus purpureus* is large and sedentary, with long sprawling legs and body form fitted for walking. In many respects, other than size, it resembles *Caenis,* especially in the possession of elytroid gills on the second segment, which completely cover all succeeding pairs of gills. The mouthparts also are rather similar to *Caenis*. But it is not hairy, and possesses two pairs of well-developed wing-pads. In other respects it bears resemblance to *Ephemerella* nymphs, particularly in the lateral extensions of the abdominal segments, but has one median instead of two lateral spinous dorsal processes. In general appearance, it would be taken at once for a nymph of the subfamily Baetinae (Needham). The wing venation of the adult insect, however, places this genus in the subfamily Ephemerinae, since the cubital and first anal veins are strongly divergent at the base.

Nymphs of *Oreianthus purpureus* from Davidson River were taken in swift water, at a depth of from one and one half to two feet. They were obtained only by moving the large flat or slightly irregular rocks on the stream bed with a rake, meantime holding the screen in the current below, to catch the wash. The swiftness of the current and the large size of the rocks made such collecting no easy task. These nymphs were by no means plentiful, as evidenced by the fact that a four-hour search for them on June 20, 1930, yielded but two nymphs. Other aquatic larvae were more numerous, however, as indicated by the following list of associated forms. These included, among mayflies, five species of Ephemerella, two species each of Ecdyonurus, Epeorus, and Chirotonetes, and one species each of Heptagenia, Baetis and Leptophlebia. Trichoptera were represented by Hydropsyche, Brachycentrus, and Rhyacophila; Odonata by Lanthus. The most numerous Plecoptera were of the genera Perla, Perlinella, Pteronarcys and Acroneuria. Many large Corydalis and Chauliodes, and the cranefly

*Contributions from the limnological laboratory, Cornell University.

Eriocera, were also present. Of the five nymphs of *Oreianthus purpureus* taken during 1929 and 1930 at this station, three were males, all of which failed to transform. One female subimago transformed on June 22, 1929, and a female imago on June 30, 1930.

## **Oreianthus** n. Gen.

In fore wing, first anal and first branch of Cu strongly divergent at the base. $Cu_2$ definitely branching from $Cu_1$, not appearing to arise from the stem of first anal, as is the case in Rhoenanthus. Long intercalary vein between $Cu_1$ and $Cu_2$. First anal forked about halfway to wing margin. In hind wing, costal angulation similar to Rhoenanthus. Cubitus vein (Morgan; median vein of Tillyard) forked somewhat more than halfway to margin. (Fig. 11). Claws unlike each to each, on all legs. Foreleg of female 7/16 the length of the body. Tarsus equal to 3/5 of femur, tibia slightly longer than femur. In second and third legs, femur and tibia equal. Last tarsal joint longest, on each leg. (Figs. 12-14). Pleural folds on segments 1-9 developed into expanded plates. The posterior lateral angles of these, on segments 8 and 9, produced into backward-projecting spinous processes. Tails equal in size and length. In subimago, slightly longer than body (broken in imago). Ninth sternite of female with backwardly-directed median extension on posterior margin. Lateral ocelli slightly larger than the median one. Prosternum produced into a median carina. Anterior portion of mesosternum with a smaller and more rounded prominence. Forceps of male with one short distal joint (Fig. 6, genitalia of mature male nymph).

*Nymph*—Head almost twice as wide as long. Second joint of antenna almost as long as first, but more slender. Compound eyes of male nymph not contiguous dorsally. Prothorax slightly longer than head medially, considerably longer on lateral margins. Mesothorax with semicircular lobe at front of thin lateral margin. Body widest at greatest width of mesothorax, just anterior to base of metathoracic legs. In mature nymph, covers of first pair of wings extend backward to middle of sixth abdominal segment. Metathorax almost concealed dorsally by wing covers of first pair. Second pair of wings project slightly from beneath first pair. Short median backward-projecting spine on posterior margin of metathorax. Legs long, finely-haired throughout their length. Claws simple. Hind legs longest, equal in length to abdomen. On first abdominal segment, small upturned gill. On second segment, elytroid gill covers, cemented together on median line, covering all succeeding pairs of gills. Lateral margins of segments 3 -9 prolonged into flattened processes, not prominent on segments 3 -5, very pronounced on 6 -9. Lateral angles becoming progressively more acuminate on 6 -9, the projection on 9 quite large. Median spines on segments 1 -2, 6 -8, and a rounded projection on 10. Spines most prominent on 1 and 2, least prominent on 8. Abdomen narrows gradually back of 6th segment.

Type of this genus, *Oreianthus purpureus* n. sp.

## **Oreianthus purpureus** n. sp.

*Measurements*

| | Body | Tails | Foreleg | Forewing |
|---|---|---|---|---|
| Male nymph (3 specimens) | 14-15 mm. | 10-10.5 mm. | | |
| Female nymph (2 nymph sloughs) | 16-17 | 10.5 | | |
| Female subimago (1 specimen) | 14 | 15 | 6 | 15 |
| Female imago (1 specimen) | 16 | Broken | 7 | 17 |

NYMPH, (figs. 1-5, 7 -10, and 15. ). Large elongated form, legs very long and sprawling.

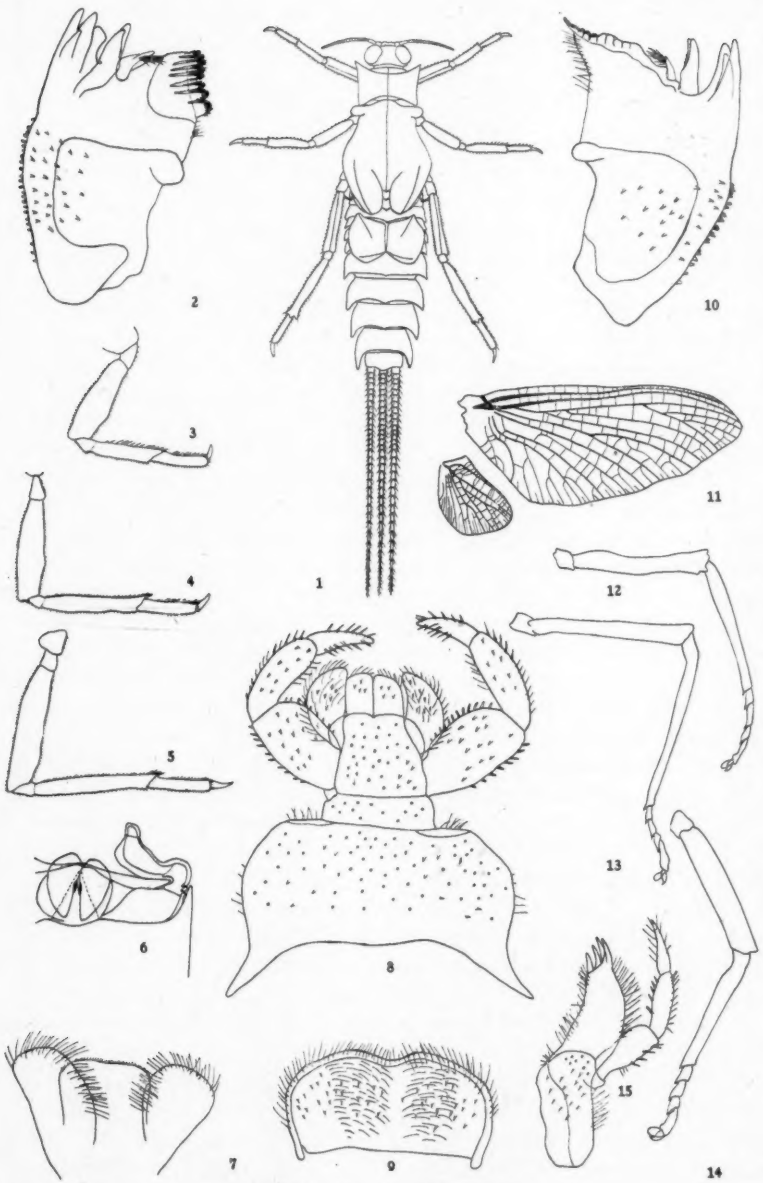
*Head*—a few very short hairs on each antennal joint, just below each joining. Ocelli not readily seen. Front of clypeus with many upwardly-directed short spines. Similar short spines directed outward and downward on frons, vertex and occiput. Head dark brown, antennae lighter brown.

*Mouthparts*—Labrum indented on anterior margin, its dorsal surface beset with upward-projecting spines. Mandible with four outer and two inner canines. Lacinia curved, brush of hairs extending out from one side near tip. Outer margin curving sharply outward from base and gently inward to canines; its lower two-thirds serrated or set with spines. Molar surface of right mandible with fine hairs. Base of mandible with inwardly-directed spines. Inner margin with thumblike projection. Maxilla bears four stout spines on its crown. Both margins closely set with long hairs and bristles. Rather distinct division between galea-lacinia and stipes. Maxillary palp longer than galea-lacinia, its palpifer well-defined. Proximal and second joints equal in length, distal joint somewhat shorter than either of others. Hypopharynx, median lobe squarish, its free margin almost straight; slightly shorter than lateral lobes. Labium, glossae and paraglossae definitely separated from ligula. Labial palp well developed, its proximal joint expanded, its distal joint terminating in a point. Entire palp longer than paraglossa. Labium set with short spines.

*Thorax*—Lateral margins of prothorax twice its median length, due to forward and backward projections of the anterior and posterior angles. Anterior angle sharp at tip, posterior angle rounded. Prothorax distinct from mesothorax. Thorax dark brown; flattened margins light red-brown. Wing cases black in mature nymph, dark brown in younger forms. Venter but little lighter than dorsal sclerites.

*Legs*—No spines or teeth on claws. At proximal end of each tibia, joint is narrowed and then dilated into rounded enlargment, giving appearance of a shorter extra joint. Tibia increases in length from first to third leg in greater proportion than femur or tarsus. Length of the leg segments as follows;

| | Femur | Tibia | Tarsus |
|---|---|---|---|
| 1st leg | 2¼ mm. | 2 mm. | 1¼ mm. |
| 2nd leg | 2½ mm. | 2¾ mm. | 1⅜ mm. |
| 3rd leg | 3⅛ mm. | 3¼ mm. | 1½ mm. |




*Oreianthus purpureus* n. sp.

Fig. 1—Mature nymph, dorsal aspect. Figs. 2 and 10—Left and right mandibles of nymph. Figs. 3, 4, and 5—1st, 2nd, and 3rd legs of nymph. Fig. 6—Genitalia of male subimago, dissected out from mature nymph. Fig. 7—Hypopharynx of nymph. Fig. 8—Labium of nymph. Fig. 9—Labrum of nymph. Fig. 11—Wings of female imago. Figs. 12, 13, and 14—1st, 2nd and 3rd legs of female imago. Fig. 15—Maxilla of nymph.

Femur of first leg considerably more flattened than on other legs. Legs brown in color, flattened. Femur of foreleg margined on sides and at each end with red-brown. Enlarged portion of tibia at femoro-tibial joint and at each tarsus, light yellow-brown. Claw yellow-brown, tipped and margined with red.

*Abdomen*—Lengths of abdominal segments, (in eighths of millimeters,) are to each other as; 6; 5; 5; 5; 5; 8; 10; 12; 5. Elytroid gill cover on segment 2 extends backward over anterior one-third of segment 3, covering gills on segments 3 -6 completely. Ridge or carina on this elytroid gill, from anterior outer angle slanting toward center. Elytroid gill finely ciliated on lateral and posterior margins. Abdominal segments 3 -9 finely ciliated on pleural margins. Posterior margin of 9th sternite produced backward into median spinous process, equal in length to lateral projections. On each side of this long median process is a smaller rounded lobe. Color of abdomen dark brown above, red-brown ventrally Flattened lateral margins lighter red-brown. Anterior of each sternite irregularly mottled with dark brown. Indistinct small black spot on each side of sternites 1 -8, at anterior margin about midway between median line and pleural fold.

*Tails*—Dark brown on proximal half, light red-brown on distal half (in young nymphs, light red-brown for entire length). Narrow black band across base of all three tails, near body.

FEMALE SUBIMAGO. Head and thorax dark purplish-brown. Pronotum and edges of mesonotum very dark, rest of mesonotum tinged with chestnut brown. Compound eyes very dark grey; bases of ocelli black. Light band on each side of head, from inner margin of compound eye to median of vertex. Legs dark purplish-brown, claws light brown. Wings dark sepia-brown, veins black or very dark brown. Abdomen purplish, tinged with brown. Tails very dark purplish brown or black.

FEMALE IMAGO. Body stout, especially at mesothorax. Head relatively small. General color purplish, except mesothorax, which is brown.

*Head*—Antennal sclerites and ocelli white. Compound eyes dark grey. Light mark from inner margin of compound eye to vertex, as in subimago. Antennae and remainder of head purplish-brown.

*Thorax*—Pronotum carved out widely on median posterior margin, forming an arcuate indentation into which the mesonotum fits. Pronotum purplish brown, mesonotum light brown, becoming chestnut-brown on its posterior projection. Metanotum light purplish-brown. Pleura light tan with brown-purple markings. Prosternum and anterior portion of mesosternum light grey mottled with purple. Remainder of thoracic sternites purplish brown.

*Legs*—First and second leg purplish-brown. Femur grey at jointing with trochanter. Tibia light yellow-brown at each joining. Each tarsal joining with yellow mark on inner margin. Claws purple-brown, yellow at base; pointed claw also yellow at tip. Third leg light brown, marked at joints with purple-brown.

*Wings*—Transparent. Veins, particularly costa, subcosta and radius, dark purple. Tip of costal angulation of hind wing purple. Membranes at bases of wings grey-white.

*Abdomen*—Reddish purple, lighter ventrally. Pleural folds dark purplish-brown. Tergites 1, 2 and the anterior half of 3 lighter than remainder of abdomen, and with indistinct brown mottling. On median line of 1 and 2, a dark bar. Tergites 3-5 uniform purple, with light streak at median line. On each, a ramifying white or grey line arising from the anterior inner margin of the pleural fold and extending, with its branches, almost to the median line. Similar light lines on remaining tergites, but much more branched. Light grey spot in pleural fold of tergites 1 -7; oblong on 1, round on 3 -5, very small on 6 and 7. Tergites 6 -10 purple-brown with light purple mottling. At median line of 6, irregular brown pattern. Sternites 1 -5 very light purple mottled with light brown. Sternites 6 -9 similarly mottled, but with background of purplish-brown. Dark purplish spot near pleural fold, at anterior margin of each sternite except 8 and 9, in which it extends the length of the sternite, and 10, from which it is absent. Sternite 10 grey marked with purple.

*Tails*—Very dark purplish brown or black. Second, third, fifth and sixth proximal joints shorter than others. Short hairs along entire length of each joint, slightly longer hairs at each joining.

*Holotype*—♀ imago. Reared from nymph taken in Davidson River, N. C. June 30, 1930. No. 975.1 in Cornell University Collection.

*Paratype*—♀ subimago. Same location, June 22, 1929. No. 975.2 in Cornell University collection. Two mature nymphs, male, same location, June 19, '29, and June 20, '30. No. 975.3 and 975.4 in Cornell collection.

In 1871, Joly described and figured a nymph from the Garonne River, near Toulouse, as *Caenis maxima*. In 1873, 1875 and 1876 he refers again to this nymph, repeating his original figures in the two latter papers. Eaton had suggested (in private correspondence) the possibility that this nymph might be a young *Tricorythus*. But in 1881 he writes that, after examining other specimens in a better state of preservation, he thinks it "more likely to be a real *Caenis*". In 1883-87, however, he refers this species tentatively to *Tricorythus*, "provisionally" describing it as such, with detailed figures of the nymph and its structures. He adds; "I am disposed to suspect that this nymph has been too hastly referred to *Tricorythus;* the adult may be of a genus at present unknown; but I could not distinguish the venation of the wings satisfactorily in the nymph, and therefore this is only a conjecture". Vayssiere, 1882, makes this nymph the basis for his study of the genus *Tricorythus*, figuring and describing it in detail, and mentioning the small second pair of wings. Lestage, in 1917, after a considerable discussion of the nymph and a brief resume of its characters, decides it is really a *Caenis*. Rousseau, 1921, treats it as the only European species of *Tricorythus*, yet expresses a doubt as to whether or not it really belongs to that genus.

A comparison of the published figures of *Caenis maxima* Joly with the figures of the nymph of *Oreianthus purpureus* leaves no reason to doubt that Joly's nymph belongs, neither to *Caenis* nor to *Tricorythus*, but to the new genus *Orcianthus*. Eaton was therefore quite correct in his idea that the adult of this nymph might be of an unknown genus.

Joly's nymph, on the basis of the structure of the elytroid gills, could not be a *Tricorythus*, nor do its mouthparts correspond to those of the latter genus.

It differs considerably from *Caenis* in the appearance of the external margin and the canines of the mandibles. Further, the elytroid gills are grown together on the median line, and the body is not hairy. Finally, the presence of a second pair of wings would ordinarily distinguish this nymph from both *Caenis* and *Tricorythus*. That Joly's nymph is a different species from *Oreianthus purpureus* is evidenced, furthermore, by two characters. First, the size and shape of the pronotum, which in *O. purpureus* is much lengthened on the lateral margins, its anterior angle produced into a sharp point. Second, the median dorsal spines, which in Joly's nymph are present on the first two abdominal segments only, in *O. purpureus* are present also on segments 6 -8, not counting the rounded projection on segment 10.

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## SUBTERRANEAN INSECTS OF MARSH GRASS (*SPARTINA MICHAUXIANA* HITCHCOCK).[1]

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During the summer of 1929 it occurred to the author to collect the subterranean insects of stands of marsh grass (*Spartina Michauxiana* Hitchcock). No large areas of this grass were found in the vicinity of Ames, Iowa. The places of study hence were restricted to a half dozen small spots along the fence lines of tilled fields near Ames. The soil was a black loam and not well-drained at these places. The digging in this tough sod proved rather a slow procedure. With a spade a piece of sod about six by eight inches was loosened at a time and the mass of rootstocks, roots and soil was separated at the side of the road to bring the insects into view. This method did not lend itself to quantitative study.

[1]Contribution from the Department of Zoology and Entomology, Iowa State College.

On June 29 a piece of sod twelve inches square and eight inches deep was brought in a covered container to the laboratory. A count of the living visible animal life was made. This count interpreted in terms of one acre yielded 1,570,000 animals per acre of Spartina sod.

In total, an area of approximately fifteen square feet in several patches was dug to a depth of eight inches. Of the insects secured, the following have been identified. The number after each date refers to the number of adults taken unless otherwise noted.

Order NEUROPTERA

*Psectra diptera* L. June 22, one.

Order ORTHOPTERA

*Gryllus assimilis* Fab. July 5, one first instar nymph.
*Ceuthophilus* sp.. July 5, one adult female.

Order HOMOPTERA

*Remadosus magnus* O. & B. July 5, one.
*Phlepsius nebulosus* Van D. June 27, 29, July 5, six.

Order COLEOPTERA

*Eumolops sodalis* Lec. June 29, one; July 5, one.
*Abacidus sculptus* Lec. July 5, three.
*Abacidus permundus* Say. June 29, one.
*Calathus gregarius* Dej. June 22, one; June 27, one; July 5, three.
*Anisotarsus terminatus* Say. July 5, one.
*Philonthus umbrinus* Grav. July 5, four.
*Staphylinus cinnamopterus* Grav. June 27, one.
*Hemicrepidius brevicollis* Cand. (?) June 27, one.
*Melanotus communis* Gyll. June 27, one.
*Stilbus apicalis* Melsh. June 22, one.
*Eucanthus lazarus* Fab. June 27, one.
*Ligyrodes relictus* Say. June 22, June 27, June 29. One adult on each date.
*Rhabdopterus picipes* Oliv. July 5, one.

Order HYMENOPTERA

*Gelis* sp. June 22, one.
*Habropelte fuscipennis* Ashm. June 22.
*Ponera coarctata* subsp. *pennsylvanica* Buck. June 27, one.
*Stenamma brevicorne* subsp. or var. June 27, two.
*Leptothorax curvispinosus* Mayr. June 29, one.
*Lasius niger* var. *neoniger* Emery. June 29, one.
*Lasius umbratus mixtus* var. *aphidicola* Walsh. June 27, two; June 29, two.
*Camponotus herculeanus liggniperdus* var. *noveboracensis* Fitch. July 5, three.

The author is indebted to the following systematists for the naming of the species: Mr. Nathan Banks, *Neuroptera;* Dr. B. B. Fulton, *Orthoptera;* Mr. G. Stuart Walley, *Homoptera;* Mr. W. J. Brown, *Coleoptera;* Messrs. R. A. Cushman and A. B. Gahan, and Dr. M. R. Smith, *Hymenoptera.*

A number of larvae of *Carabidae, Elateridae* and *Scarabidae* (*Coleoptera*) were secured but not identified. Approximately twenty larvae of the Noctuid moth *Luperina stipata* Morr. were uncovered together with several other unidentified Lepidopterous larvae.

# NOTES ON THE CHERMIDAE (HEMIPTERA: HOMOPTERA). PART II.

BY F. D. KLYVER

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In the second paper of this series I have selected for discussion the nymphal stages of three species. The first of these is *Paurocephala fremontiae* F. D. Klyver, the adults of which are described in the preceding paper. The other species considered are *Psylla pyricola* Förster and *P. mali* Schdbg., both of which are of special interest because of their economic importance. The nymphal stages of neither species have been adequately figured nor described in detail.

## Paurocephala fremontiae F. D. Klyver

Fig. 1.

1930, *Paurocephala fremontiae* F. D. Klyver. Can. Ent. LXII, 174.

SPECIMENS EXAMINED. The shed skins of several stages from *Fremontia californica* Torr., four miles east of Auberry, Fresno County, California, August 3, 1929 (F. D. Klyver). Nymphs of the fourth and of the last stage and several shed skins from *Fremontia californica* Torr., two miles west of Tehachapi, Kern County, California, April 13, 1930 (F. D. Klyver).

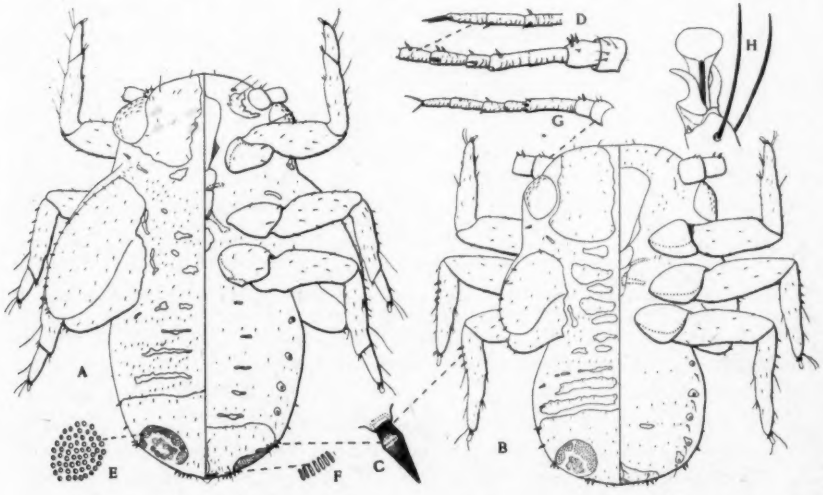


Fig. 1. *Paurocephala fremontiae* F. D. Klyver. A.—Fifth stage of nymph; B.—Fourth stage of nymph; C.—Dagger-like seta of antennae, wing pads, legs and abdomen; D.—Antenna of fifth stage of nymph; E. Pore area of outer series; F.—Circum-anal ring of pores; G.—Antenna of fourth stage of nymph; H.—Apex of tarsus.

NYMPHAL STAGES. My material includes specimens of the last two stages, presumably the fourth and fifth stages. The nymphs move about freely on the under side of the leaves of the host and on the smaller twigs apparently causing little harm and no distortion of the host.

*Fifth stage* (Fig. 1A). Length 1.4 mm. Of psylliine form. Head as broad as the abdomen and the wing pads extending prominently beyond the general margin of the body. The derm membraneous except for the chitinized areas

of the head, wing pads, the posterior third of the abdomen, and the smaller areas of the thorax and the abdomen as shown in the figure (Fig. 1A). Antennae of moderate length, ten-segmented; segments 2 to 8 inclusive bearing short, stout, dagger-like setae (Fig. 1C) of the same type occurring on the legs, wing pads, and the abdomen; the terminal setae of the last segment each with a slight knob-like enlargment at the tip. The anterior pair of wing pads each bearing a marginal row of short, stout, dagger-like setae, the posterior pair having three similar setae on the distal margins. Legs without trochanter; the tarsus with a relatively large empodium (Fig. 1H); the tibia of the middle pair and the hind legs having a row of setae similar to those on the antennae, wing pad margins, and abdomen. Abdomen having several groups of setae located at the side and posterior end as illustrated and rows of small setae, most of them short, stout, and blunt-ended but others somewhat longer and sharply pointed. Anus at the extreme tip of the abdomen, surrounded by a ring of simple pores (Fig. 1F). The pores of the caudal chitinized area appearing on each side as two large patches separated from the curcum-anal ring of pores, being continuous from the dorsal to the ventral side of the abdomen but chiefly dorsal in position. Each of these patches has an outer series of conspicuous pore areas consisting of large pores and an inner series of weakly defined pore areas.

Ventral side largely membraneous except for the chitinized areas at the base of the antennae, the area over the posterior fourth of the abdomen, and the few small areas distributed as shown in the figure (Fig. 1A).

*Fourth stage* (Fig. 1B). Length .7 mm. Differing from the fifth stage in the head and thorax being noticeably broader than the abdomen; in the considerably reduced size of the wing pads; in the proportionately greater amount of chitinization on the dorsal side; in the shorter, seven-segmented antennae; and in the absence of the tibio-tarsal articulation.

## **Psylla pyricola** Forster

Fig. 2.

1848, *Psylla pyricola* Forster. Verh. d. Nat. Vereins d. Preussischen Rheinlande. 1848:67-98.
1914, *Psylla pyricola* Forster. Crawford, Bull. U. S. Nat. Mus. 85:144; figs.

SPECIMENS EXAMINED. Nymphs of five distinct stages including the first and the fifth or final stage from *Pyrus persicolor*, Rochester, N. Y., July 16, 1923 (Herrick).

NYMPHAL STAGES. Crawford has partially described four nymphal stages and apparently considers there to be only four immature stages in this species. My material includes five distinct stages.

*Fifth stage* (Fig. 2A). Length 1.3 mm. Of psylliine form. Head scarcely as broad as the abdomen, eyes and wing pads large and prominent. The derm for the greater part chitinized, the head and wing pads bearing large chitinized areas, the posterior two-thirds of the abdomen being covered by a single large plate and the thorax and the anterior third of the abdomen having a number of chitinized areas as shown in the figure. Antennae long and slender, ten-segmented; segments 4, 6, 8, and 9 having conspicuous sensoria. The anterior pair of wing pads having three large setae as illustrated, each seta being flattened or spatulate at the tip (Fig. 1A, D, E), the posterior wing pads each having two large similar setae at their distal end; the general surface of the wing pads bearing small, scattered, simple setae (Fig. 2C). Legs without

trochanters; the tibia of the middle pair having two large spatulate setae, the tibia of the hind legs having a single large spatulate seta; tarsus with an empodium (Fig. 2F). The posterior half of the abdomen having a number of large, conspicuous, spatulate setae varying in size as illustrated and marginal in position; the general surface of the derm bearing scattered setae of small size and simple structure; the smaller plates of the abdomen ornamented with a few peculiar comb-like structures (Fig. 2G), the large chitinized plate being densely covered by the same type of structures.

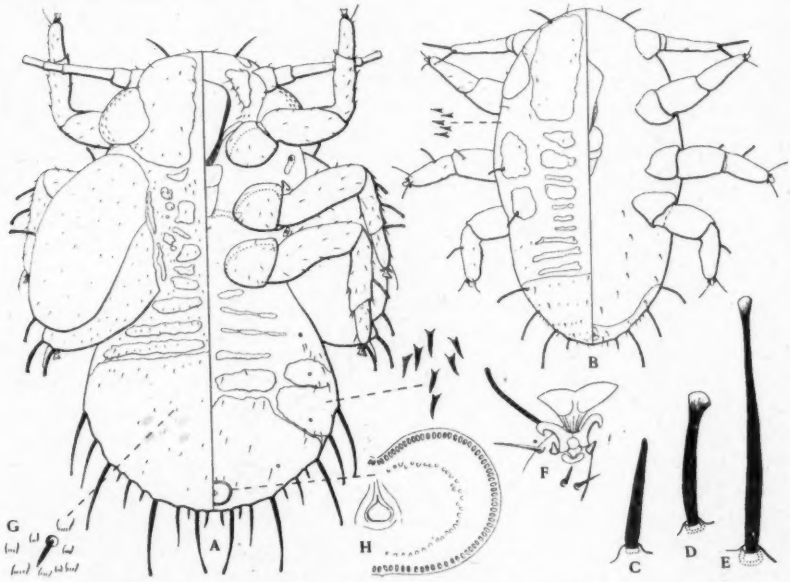


Fig. 2. *Psylla pyricola* Forster. A.—Fifth stage of nymph; B.—First stage of nymph; C.—Simple seta; D. and E.—Spatulate setae; F.—Apex of tarsus of fifth stage of nymph; G.—Comb-like structures; H.—Circum-anal ring of pores.

Ventral side with chitinized areas at the base of the antennae, small areas on the anterior half of the abdomen, and the posterior half of the abdomen almost completely chitinized, the ventral surface of the wing pads and the surface of the plates of the abdomen beset by numerous very sharply pointed spines, the spiracles being surrounded by concentric rings of short spine-like chitinized points. Anal area a short distance ventral from the apex of the abdomen, the curcum-anal ring of pores consisting of a single ring of slit-like pores and an inner ring of less well defined pores (Fig. 2H).

*Fourth stage.* Length 1.0 mm. Differing from the fifth stage in having shorter, stouter, seven-segmented antennae; and in the absence of the tibio-tarsal articulation.

*Third stage.* Length .7 mm. Differing from the fourth stage in the smaller and less conspicuous wing pads; and in the shorter, five-segmented antennae.

*Second stage.* Length .5 mm. Differing from the third stage in the shorter three-segmented antennae; in the still greater reduction of the wing

pads, and in the number and type of setae on each pad, each pad here having but two large marginal setae, the anterior seta in each case being comparatively short and simple in structure, the posterior seta in each case being larger and spatulate at its tip.

*First stage* (Fig. 2B). Length .2-.3 mm. Differing from the second stage and the other stages in the difference in general appearance; in the complete absence of the wing pads, here represented by two pairs of rudimentary chitinized plates each bearing a large spatulate seta; in the weakly three-segmented antennae, the second segment being scarcely distinct; in the different arrangement of the chitinized plates; and in the reduced number of large setae.

## **Psylla mali** Schdbg.

Fig 3.

1836, *Chermes mali* Schdbg. Beitr. z. Nat. schadl. Ins. IV:186-199.
1848. *Psylla mali* Forster. Verh. naturw. Ver. preuss. Rheinlande. 3:72.

SPECIMENS EXAMINED. Six nymphs all of the last stage from *apple*, Nova Scotia (Brittain). Date wanting.

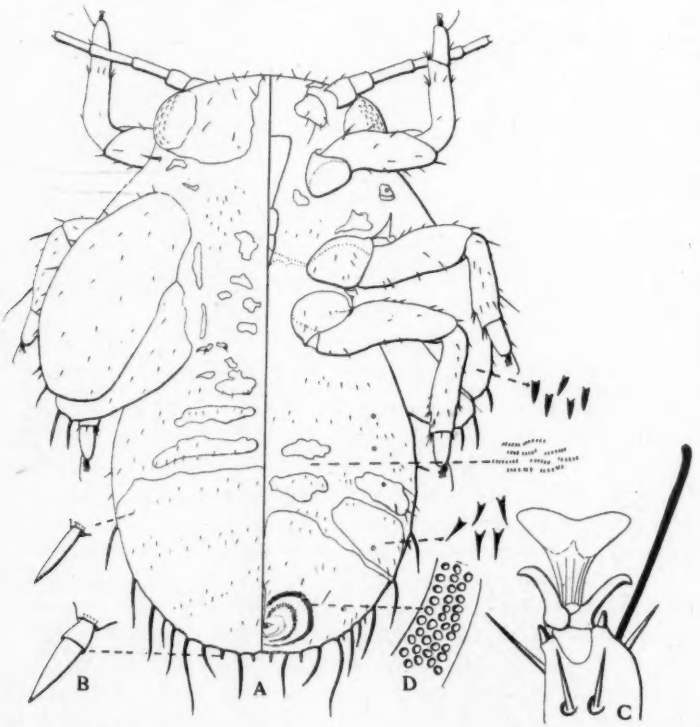


Fig. 3. *Psylla mali* Schdbg. A.—Fifth stage of nymph; B.—seta; C.—Apex of tarsus; D.—Portion of outer series of circum-anal ring of pores.

NYMPHAL STAGES. *Fifth stage* (Fig. 3A). Length 2.1 mm. Of psylliine form. Head noticeably narrower than the abdomen and the wing pads extending prominently beyond the general margin of the body. Chitinized

areas covering the head, wing pads, and the lower half of the abdomen, the derm otherwise membraneous except for the areas shown in the figure (Fig. 3A). Antennae long, slender, ten-segmented. The head bearing a number of simple setae of rather large size. The wing pads having a number of marginal setae and two relatively large setae at the distal end. Tibia of the middle pair and the hind legs having two long setae; tarsus with an empodium (Fig. 3C). Abdomen with a row of marginal setae of two types, a number of long, variously curved setae, and several short, stout setae, the latter near the apex of the abdomen (Fig. 3B).

Ventral side largely membraneous except for the chitinized areas at the base of the antennae and on the lower part of the abdomen as illustrated (Fig. 3A), the chitinized areas, and, to a less extent, the membraneous parts, of the wing pads and the abdomen covered with small to minute spine-like structures varying somewhat in general form. The anus ventral and set forward a short distance from the end of the abdomen, surrounded by an outer and an inner ring of circum-anal pores (Fig. 3D), the inner ring composed of indistinctly defined pores of various shapes.

## NEW SPECIES OF COLEOPTERA (II)*

BY W. J. BROWN,
Ottawa, Ont.

### **Agabus verus** n. sp.

Length 8.4-9.3 mm.; width 4.3-4.8 mm. Moderately elongate, oval. Black; dorsum feebly shining and with a very feeble aeneous tint; two spots on the vertex, the anterior part of the head, and sides of elytra usually brown or brownish-yellow; antennae yellow, with four or five apical segments brown; palpi yellow, the apical segment of each brown; prosternum and legs dark brown.

Head very finely reticulate, the areolae very minute throughout, but less so near apex; the minute punctures very indistinct, not situated within the areolae. Pronotal reticulation similar but slightly less fine; the apical and subbasal bands of coarse punctures conspicuous, the latter broadly interrupted at middle.

Elytral reticulation very fine, very deeply impressed; the areolae, very small, rounded, equal; the minute punctules as on the head and pronotum; the irregular series of coarse punctures quite evident.

Prosternal process very slender, very acutely carinate, the apex very finely acuminate. Metasternal wings very narrow, sublinear externally. Coxal lines much approximated, abruptly turned outward at apex. Hind tibia with an entire row of punctures on the inner margin and with numerous accessory discal punctures at base.

*Male.* Equal in size to the largest females. Seventh antennal segment slightly dilated, the four terminal segments very strongly dilated, flattened, strongly excavate beneath, the terminal segment acuminate. Posterior lower margin of front femur densely ciliate with very long hairs. Front tarsus very broad, the four basal segments together about five-sevenths as wide as long, the three basal segments bearing large circular palettes; the claws elongate,

*Contribution from the Division of Systematic Entomology, Entomological Branch. Dept. of Agric., Ottawa.

slender, the anterior straight beneath to apical fourth, the other very feebly curved beneath. Middle tarsi a little less strongly widened. Hind femur with the ventral face rounded into the posterior face, these faces separated by an acute margin only at the insertion of the tibia; hind tibia with the inner side densely ciliate with moderately long hairs, without other modification; first segment of hind tarsus with the lower side ciliate like the tibia and similarly without other modification.

*Female.* Antennae and legs without modification, the hind femur with the ventral and posterior faces distinctly separated throughout and separated by an acute margin in apical half. Pronotal reticulation less fine, the areolae a little larger than in the male. Elytral sculpture as in the male.

*Holotype*—♂, Ft. Churchill, Man., Aug., 1929, (F. Johansen); No. 3171 in the Canadian National Collection, Ottawa.

*Allotype*—♀, same data.

*Paratypes*—5 ♀, same data.

This species is closely allied to the Old World species, *serricornis* Payk. and *clavicornis* Shp. but, judging from the descriptions of these, differs from both in the characters of the male posterior legs as well as in other characters. The North American *clavatus* Lec., associated with these species on account of the clavate male antennae and very narrow metasternal wings, differs greatly from *verus* in size, color, sculpture, and male sexual characters. In facies, *verus* resembles the larger *nigroaeneus* Er.

### **Ochthebius insulanus** n. sp.

Length 1.8 mm.; width .8 mm. Moderately robust and convex; aeneo-piceous above, the venter brown or black, the legs yellow. Labrum with a shallow, triangular emargination; ultimate segment of maxillary palpus about twice as long as wide, parallel, bluntly pointed; front with a very large fovea on each side and with a small but very distinct median fovea near the pronotal margin.

Pronotum two-thirds as long as wide, widest three eights from apex; the anterior margin subtruncate; the anterior angles distinct but not prominent; the side margin rather feebly arcuate to middle, there abruptly and deeply emarginate, the angle thus formed almost rectangular and very slightly prominent, the side margins straight and very feebly converging behind the emargination; the basal margin broadly and rather strongly lobed at middle; lateral transparent border almost regularly arcuate from apical angles to base, very narrow in front of the emargination. Pronotal disk coarsely and closely punctate, the intervals between the punctures polished and without sculpture; the median impressed line deep, rather narrow, well separated from the basal and apical margins; discal foveae not sharply defined, well separated, the anterior slightly longer than wide, the posterior about twice as long as wide and separated by distances equal to its length from the median and lateral impressions; lateral impressions rather broad, the disk flat between these and the lateral margin.

Elytra with the sides explanate to apical fourth; the striae closely and coarsely punctate; the intervals feebly convex, with very fine, transverse wrinkles, much wider than the striae except at sides and apex.

*Holotype*—Victoria, Vancouver Island, B. C., (H. F. Wickham); No. 3173 in the Canadian National Collection, Ottawa.

*Paratype*—1, same data.

In Horn's table, this species falls near *rectus* and *discretus*. The pronotum is similar in form to that of *rectus* except that the sides are arcuate before the constriction and the constriction is much more abrupt. The pronotal impressions are similar to those of *discretus* except that the median impressed line is narrower and shorter and the discal foveae are smaller in the present species.

**Tropisternus columbianus** n. sp.

Length 9.5-10 mm.; width 5-5.3 mm. Dorsum black throughout, feebly but distinctly bronzed; ventral surface blackish, the mesosternal portion of the keel dark brown with yellow sides, each abdominal segment usually with a very faint yellow spot on each side; antennae, palpi, elytral epipleura, and inflexed sides of pronotum yellow or brownish; legs bicolored, the anterior largely yellow, the middle and hind tibiae with the outer side yellow; the hind femora yellow at apex except near posterior margin, this yellow area extending over one-quarter of the femoral surface in mature specimens, middle femora similar but with the yellow area slightly larger.

Systematic punctures of pronotum well developed, each series consisting of four or more punctures. Elytra very finely, not densely punctate, the punctures less fine and unequal near apex; punctures of epipleural margin fine, extending in an entire series from extreme base to a point near apex.

Mesosternal portion of keel only slightly wider, the free caudal portion with a very fine median groove. Pubescent area of middle femur triangular, very small, confined to the extreme base, not attaining the apex of the trochanter; pubescent area of hind femur similar but prolonged to apex of trochanter in a fine line. Terminal abdominal segment carinate in apical half.

*Male*. Mentum and sides of submentum closely punctate, many of the punctures separated by not more than their diameters. Mesosternal portion of keel sparsely and coarsely punctate, a few very fine punctules near the sides; metasternal portion of keel with a few fine punctures. Inner claws of middle and hind tarsi toothed.

*Female*. Mentum and sides of submentum sparsely punctate, keel with a few very indistinct punctules, a few moderately coarse punctures at the anterior extremity. Tarsal claws not toothed.

*Holotype*—♂, Malahat, Vancouver Island, B. C., Sept. 4, 1929, (W. H. A. Preece); No. 3172 in the Canadian National Collection, Ottawa.

*Allotype*—♀, same data.

*Paratypes*—1 ♂, same data; 1 ♀, same data, Aug. 30, 1929; 1 ♀, Vancouver Island.

This species is closely allied to *californicus* and has been confused with the latter in collections. In *californicus* the clypeus is conspicuously marked with yellow, the yellow areas of the middle and hind femora are more extensive, the dorsum is not bronzed, the punctures of the epipleural margin are larger, and in both sexes the punctures of the keel are slightly more numerous.

**Enochrus collinus** n. sp.

Length 4-4.5 mm.; width 2.2-2.3 mm. Oblong oval; moderately convex; black, the sides of the pronotum and elytra very obscurely reddish-brown; antennal stem and palpi pale, tibiae and tarsi reddish brown.

Head and pronotum similarly punctate, the puncturation uniform throughout, the series of coarser punctures very distinct. Ultimate segment of maxillary palpus much shorter than the penultimate. Basal marginal line of pronotum very fine but entire.

Elytra with the sides feebly arcuate and subparallel in basal three-fifths; the puncturation a little coarser than that of pronotum, the series of coarser punctures very distinct.

Prosternum not carinate. Mesosternal lamina prominent, the summit produced and distinctly mucronate, the edge almost horizontal behind the summit, vertical in front. Terminal segment of abdomen not emarginate.

*Male.* Tarsal claws toothed and strongly curved at base, then almost straight apically; the fore tarsus with the tooth of the anterior claw acute, not elongate, not everted, the tooth of the posterior claw shorter and rectangular; claws of the middle tarsus similar, very slightly sinuate, their teeth slightly acute, hind tarsal claws like those of the middle tarsi but with the teeth rectangular. Summit of mesosternal lamina very acute.

*Female.* Claws simple. Mesosternal lamina less acute at summit.

*Holotype*—♂, Covey Hill, Que., June 17, 1927, (W. J. Brown); No. 3174 in the Canadian National Collection, Ottawa.

*Allotype*—♀, same data.

*Paratypes*—16 ♂, 8 ♀, Covey Hill, Que., June 16 and 17 and July 2, 1927, (W. J. Brown and G. S. Walley).

This species falls in the *hamiltoni* group in Horn's table (Trans. Am. Ent. Soc. XVII, 243). All the species included there are pale in color, and in each, the tooth of the anterior claw of the male fore tarsus is considerably larger than in the present species. In Winters' table (Pan Pac. Ent. IV, 20) the species falls with *conjunctus* Fall which was described from Southern California and which is said to have the tarsal claws toothed somewhat after the manner of *hamiltoni* Horn.

**Helichus columbianus** n. sp.

Length 5.3 mm.; width 2.6 mm. Moderately elongate, rather robust. Black; body with reddish hairs throughout, rendered opaque by the earthy coating. Head with densely placed, minute granules, the vestiture moderately close; vertex with a broad depression.

Pronotum three-fourths as long as wide, widest at basal third; the sides moderately arcuate, not distinctly sinuate before the hind angles. Disc not strongly declivous before base, not tumid on each side of the median line; the latter broadly and vaguely impressed in basal third; the impression on each side broad and vague, not deep or elongate; sculpture at middle consisting of close, not coarse punctures; the lateral declivities and area near base with rather close, minute granules.

Elytral striae rather wide and not deeply impressed, closely, very coarsely punctate. First second and third intervals very finely, rather closely punctate,

with minute granules at base, the third with a few granules on the outer side; the remaining intervals with close, minute granules; the third interval more convex and therefore slightly elevated, the fifth and seventh intervals very slightly elevated except at base and apex.

Apical abdominal segment roughly punctate, not densely clothed with hairs.

*Holotype*—Copper Mt., B. C., March 30, 1930, (G. Stace Smith); No. 3183 in the Canadian National Collection, Ottawa.

*Paratypes*—1, same data as holotype; 1, same data, Dec. 1, 1929; 1, same data, April 28, 1930; 2, Duncan, B. C., (A. W. Hanham).

The paratypes measure from 5 to 5.3 mm. in length. The species is closely allied to *striatus* Lec. and would be identified as such by Horn's paper (Trans. Am. Ent. Soc. III 31-33). In the latter, the body is more elongate; the pronotum is more strongly declivous before the base and has the depression on each side deeper and often elongate; the alternate elytral intervals are usually much more convex. The present species is as robust as *fastigiatus* Say.

M. Smith informs me that his specimens of *columbianus* were taken from a mountain stream at 3200 ft. altitude at a point where the stream enters a small meadow.

### **Ceutorhynchus opertus** n. sp.

Length 2.5-2.7 mm.; width 1.4-1.5 mm. Oblong; black throughout; moderately shining; vestiture of dorsum close, consisting of broadly oval, appressed, white scales which are not uniform in size and suberect, brownish-yellow, flattened setae; underside densely clothed with broadly oval, white scales, the abdomen with a few setae similar to those of the elytra; legs, including the tarsi, with narrower but wide and large, dense, white scales and similar setae.

Head finely and densely punctate; front flattened, clothed with moderately wide scales similar to those of the legs; vertex densely scaley, with a long, very fine, median carina; beak punctate and striate in basal half, very finely and sparsely punctulate apically, naked. Antenna with the funicle of seven segments; the club moderately elongate, acuminate.

Pronotum four-fifths as long as wide, densely and rather coarsely punctate; the anterior constriction very strong, the sides moderately rounded behind; the apical margin very strongly elevated, with a small triangular notch at middle; the median channel feeble; the lateral tubercles large, conical, acute; the scales rounded, small, contained within the punctures, very few larger scales in the apical constriction and on the sides; the setae not numerous. Scutellum distinct.

Elytra slightly narrowed posteriorly, the sides scarcely arcuate; the intervals not rugose but finely and closely punctate, distinctly tuberculate on the declivity, densely scaley, the scales varying slightly in size, the setae numerous and conspicuous; strial scales very narrow.

Fourth segment of anterior tarsus slightly longer than the second and third, the portion projecting beyond the lobes of the third almost twice as long as the third segment. Femora mutic but each of the posterior pair with a tuft of scales in the position of the usual tooth; tarsal claws not toothed.

*Female.* Antennae inserted behind middle of beak; tibiae not unguiculate; last abdominal segment not impressed.

*Holotype*—♀, Oliver, B. C., May 2, 1923, (C. B. Garrett); No. 3145 in the Canadian National Collection, Ottawa.

*Paratype*—♀, same data, May 7, 1923.

This species falls near *isolatus* or *persimilis*. Notable characters are found in the vestiture of the elytra and legs, the very strongly elevated pronotal margin, and the large conical lateral tubercles of the pronotum. In neither specimen are the elytral scales and setae very regular in distribution. This is probably because the specimens are slightly rubbed; however, there is no indication that the scales are condensed to form spots in the species.

### **Ceutorhynchus carteri** n. sp.

Length 2.2 mm.; width 1.1 mm. Oblong, black throughout, moderately shining; vestiture of dorsum almost uniform throughout, consisting of brownish-yellow, hair-like, suberect setae and white, moderately wide, appressed, sharply pointed scales; underside clothed with white, closely placed, wider scales; legs with sparse whitish hairs.

Head finely and densely punctate; front flattened, without scales; beak punctate and striate in basal half, very finely and sparsely punctulate apically, naked except for a few setae at base. Antenna with the funicle of seven segments; the club broadly oval, fully two-thirds as wide as long, not acuminate.

Pronotum two-thirds as long as wide; densely, not coarsely punctate; the anterior constriction very abrupt and strong, the sides in front parallel, strongly rounded behind; the anterior margin elevated at middle, entire; the median channel entire but feeble at middle; the lateral tubercles acute and very small; the scales rather close in the median channel, on the sides, and near basal margin, sparse elsewhere. Scutellum not visible.

Elytra subparallel; the intervals subrugose, each with two or three irregular rows of scales and one or two of setae, the scales condensed at the base of the first intervals to form an elongate, poorly defined scutellar spot; strial punctures concealed by white scales which are only slightly wider than the setae of the intervals.

Fourth segment of anterior tarsus equal in length to the second and third, projecting slightly more than the length of the third; tarsal claws each with a moderate, acute basal tooth; the femora not toothed.

*Female.*—Tibiae not unguiculate; last abdominal segment not impressed; antennae inserted two-fifths from base of beak.

*Holotype*—♀, Brooks, Alta., June 11, 1923, (W. Carter); No. 3144 in the Canadian National Collection, Ottawa.

This species is closely allied to *convexicollis* and traces to the latter in Dietz's table. It is readily distinguished by the hair-like form of the suberect setae.

### **Ceutorhynchus handfordi** n. sp.

Length 1.8-2 mm.; width 1-1.2 mm. Oblong; black, the antennae and legs reddish; moderately shining; vestiture of dorsum almost uniform throughout, consisting of white, very narrow, not closely placed, appressed scales; underside with narrow but larger, rather closely placed, white scales; legs with

rather sparse hairs and very small, narrow scales.

Head finely and densely punctate; front very slightly flattened, the scales very narrow and almost hair-like; beak punctate and striate in basal half, very finely and sparsely punctulate apically, naked. Antenna with the funicle of seven segments, the club elongate and acuminate.

Pronotum seven-tenths as long as wide, densely and rather coarsely punctate; the anterior constriction strong, the sides moderately rounded behind; the apical margin moderately elevated, entire; the median channel very feebly impressed at middle; the lateral tubercles very small, acute; vestiture sparse, a few larger scales scattered along the median channel and basal margin and on the sides near base and apex. Scutellum distinct.

Elytra subparallel; the intervals subrugose, very finely muricate on the declivity, each with two rows of scales, a small scutellar spot of very slightly wider scales at the bases of the first intervals; strial scales similar to those of the intervals.

Fourth segment of anterior tarsus equal in length to the second and third, the portion projecting beyond the lobes of the third equal in length to the third segment; tarsal claws and femora not toothed.

*Male.* Antennae inserted at middle of beak; last abdominal segment with a very deep, circular depression at middle, the depression extending over the full length of the segment; middle and hind tibiae strongly unguiculate.

*Female.* Antennae inserted just behind the middle of beak; last abdominal segment as in the male; tibiae not unguiculate.

*Holotype*—♂, Aweme, Man., June 5, 1929, (R. H. Handford); No. 3146 in the Canadian National Collection, Ottawa.

*Allotype*—♀, Onah, Man., June 5, 1929, (R. H. Handford).

*Paratype*—1 ♂, same data as holotype.

This species belongs to the *squamatus* group and seems most closely allied to *convexipennis,* differing however by the coarser and closer vestiture. On account of great similarity in form and vestiture, it may be confused with *omissus,* a species in which the tarsal claws are toothed.

I know of no other species of *Ceutorhynchus* in which the terminal abdominal segment of the female is so broadly and strongly depressed at middle; there can be no doubt of the sex of the specimen, for I have removed the genitalia. Mr. Handford notes that all three specimens were collected from a species of *Lesquerella.*

**Ceutorhynchus dubitans** n. sp.

Length 2.1 mm.; width 1.1 mm. Oblong; head and prothorax blackish, antennae, elytra, legs, and venter pale reddish; moderately shining; vestiture of dorsum almost uniform throughout, consisting of appressed, brownish-yellow, narrow setae, the pronotum with a few elongate, white scales; underside with rather closely placed, white scales, legs with sparse, white setae.

Head finely and densely punctate; front flattened; beak punctate and substriate in basal half, sparsely punctulate apically, naked except for a few setae at base. Antenna with the funicle of seven segments; the club elongate and acuminate.

Pronotum three-fourths as long as wide, densely and rather coarsely punctate; the anterior constriction strong, the sides moderately rounded be-

hind; the apical margin moderately elevated, entire; the median channel entire; the lateral tubercles acute, small; the scales not numerous, confined to basal margin and median channel. Scutellum minute.

Elytral subparallel; the intervals subrugose, without scales but each with two rows of setae; finely muricate on the declivity; strial scales whitish, scarcely wider than the setae of the intervals.

Fourth segment of anterior tarsus equal in length to the second and third, the portion projecting beyond the lobes of the third equal in length to the third segment; tarsal claws each with a moderate, acute basal tooth; the femora not toothed.

*Male.* Antennae inserted at middle of beak; last abdominal segment with a large circular impression; middle and hind tibiae strongly, anterior tibiae moderately unguiculate.

*Holotype*—♂, Wenoncha, Sask., August 12, 1925, (K. M. King) No. 3143 in the Canadian National Collection, Ottawa.

This species is allied to *pusio* and *omissus* but has the the vestiture more hair-like than either. This uniformly distributed, almost hair-like, sparse vestiture of the elytra is the most striking character of the species.

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